Department of the
ENVIRONMENT

GOOD PRACTICE CASE STUDY 344

Energy savings from small, efficient melting and holding furnaces

Quinton Hazell Ltd and Brook Hansen, Huddersfield

- **Investment cost**
  Quinton Hazell Ltd
  £112,000

  Brook Hansen, Huddersfield
  £120,000

- **Total savings**
  Quinton Hazell Ltd
  £69,700/year

  Brook Hansen, Huddersfield
  £58,000/year

- **Payback period**
  Quinton Hazell Ltd
  1.6 years

  Brook Hansen, Huddersfield
  2 years

BEST PRACTICE PROGRAMME
ENERGY EFFICIENCY
BEST PRACTICE PROGRAMME

CHOOSING THE RIGHT FURNACE

BACKGROUND

Furnaces, by their very nature, are energy intensive. However, recent advances in design and technology have resulted in the manufacture of new units which are far more energy efficient than their predecessors. This has been achieved by developments in:

- automatic burner/temperature control;
- the use of insulated covers;
- low thermal mass refractories;
- heat recuperation.

Highly efficient furnaces for larger foundries have been available for some time. However, recent developments in the design of small, melting and holding units means that lower volume, non-ferrous foundries can now also benefit from energy efficient furnaces.

Although state-of-the-art equipment may be more expensive to install, the total purchase price plus running costs of a cheaper model can overtake that of an energy efficient unit within two years. As the annual energy cost of many furnaces is greater than the initial capital cost, it can be a false economy to buy a cheaper, less efficient model (Fig 1).

Fig 1 Comparative cost for different equipment models

In addition, if the furnace is running smoothly and at optimum efficiency, there is less wear and tear on moving parts, less maintenance and less danger of producing poor quality metal. This, in turn, means fewer scrap castings, lower metal losses, and less wasted effort.

Quinton Hazell Ltd and Brook Hansen, Huddersfield have both recently installed energy efficient furnaces in preference to less efficient, cheaper models. The results of these projects demonstrate the benefits that can be achieved.

The furnace and die-casting machine at Quinton Hazell Ltd

The project was monitored independently by: The Castings Development Centre. Tel: 01527 66414
The equipment was supplied by: Striko UK Ltd. Tel: 01785 818139

There may be other suppliers of similar energy efficient equipment in the market. Please consult your supply directories or contact ETSU who may be able to provide you with more details on request.

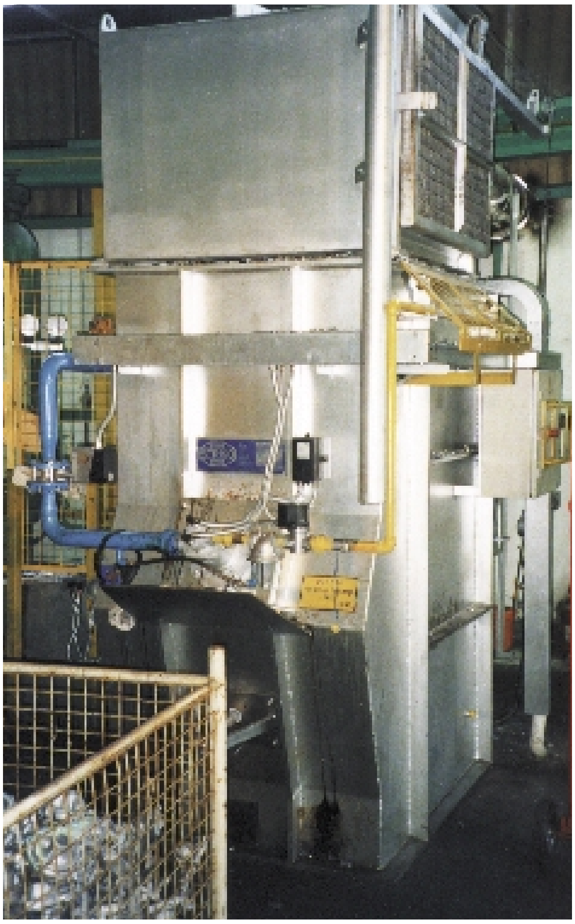
QUINTON HAZELL AUTOMOTIVE LTD

MELTING AND BALE OUT UNITS

Three new Striko MB 500/300 furnaces were installed at the Quinton Hazell Automotive plant in Colwyn Bay, during August 1994. The furnaces have a capacity of 500 kg with a maximum alloy melting rate of 300 kg/hour and a maximum working temperature of 740˚C. They supply three Idra high pressure die-casting machines with LM24 alloy and are capable of melting a wide range of charges from 100% ingot to 100% scrap.

The furnaces are equipped with separate melting and holding chambers, each heated by independent pre-set medium speed burner installations. This allows wet or oily scrap to be used safely as it is not charged directly into the molten bath.

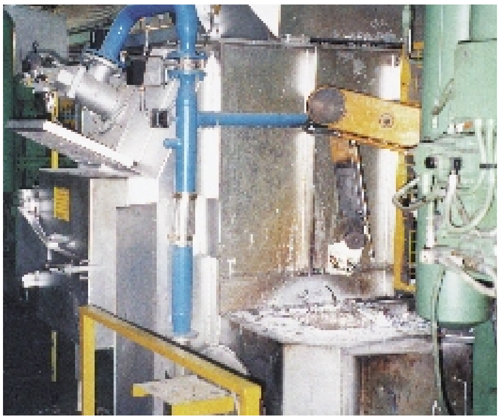
Rear view showing the secondary burner and charging door



A major design feature of this type of furnace is that charging is carried out through a vertical shaft. Flue gases pass up the shaft, pre-heating the charge. This maximises the extraction of heat from the combustion exhaust gases which exit the furnace at 150˚C - 300˚C.

When the furnace holding chamber is full, the level controller switches off the metal melting burner to avoid overfilling. Solid material already in the shaft continues to be pre-heated by the radiated heat from the melting chamber and by exhaust gases from the holding burner.

Metal is drawn from the holding area into the bale-out pocket. This prevents the transfer of any dross. A fibre-blanket lined steel cover is placed over the bale-out pocket during die changes and between shifts to further improve thermal efficiency.



Ladle dipping mechanism and primary burner at Quinton Hazell

The furnaces are free-standing and require no special foundations. Their use has eliminated the need for a metal transfer system and bulk melting, with the associated operational and safety problems. The furnaces comply with the Environmental Protection Act 1990.

BROOK HANSEN, HUDDERSFIELD

Gas-fired crucible furnace serving an Idra die-casting machine at Brook Hansen, Huddersfield

GAS CRUCIBLE BALE-OUT FURNACES

During 1994 Brook Hansen, Huddersfield purchased twelve gas-fired Striko combined melt/hold gas (CMHG) crucible furnaces ranging in capacity from 260 - 500 kg. These replaced the existing electric and oil-fired crucible furnaces used to hold LM24 alloy for the company's Idra and Triulzi high pressure die-casting machines.

The furnaces were designed around a BC302 crucible, which allows for an automatic ladle mechanism to be used. The steel shell is fitted with a low thermal mass fibre lining, resulting in heat losses of less than 1 therm/hour.

The combustion system features an industrial-type process burner with an operational turn-down ratio of 8:1. The complete system is housed within the furnace shell, including the small combustion air fan. A remote control panel contains the logic circuitry and temperature controller.

A Nu-Way Multiplex burner, capable of a thermal rating of 5 therms/hour, is used to superheat the molten aluminium from the bulk melter from 720˚C to 760˚C when required. The burner low fire rate is set for a holding thermal demand of 0.4 - 0.45 therms/hour.

A pneumatically powered lightweight refractory-lined lid moves horizontally over the crucible top to conserve heat. This can be interlocked into the die-casting machine for automatic operation, or can be moved by the operator via a simple switch selection.

The furnaces are easy to install and maintain. They have contributed directly to a general improvement in working conditions, with low casing temperatures and reduced noise levels.

Melting/holding chamber

HOST ORGANISATIONS

Converting our older electrical induction melting unit, ladle transfer system and holding furnaces to modern, gas-fired small melting/bale out-furnaces proved beneficial to our company for a number of reasons.

Firstly, there were the cost savings made from reduced energy consumption and metal losses, and from savings in labour, maintenance and consumable items. These gave a payback period on our original investment of less than two years, and justified the capital spend.

However, there were a number of intangible benefits worth noting. Firstly, with the combined melt/hold units, cold ingot cannot be loaded directly into the furnace. In the past, we found that this practice resulted in large temperature drops, affecting the control and metal cleanliness, and consequently had a detrimental effect on casting quality. Eliminating the temptation has eliminated the problem.

Secondly, the whole operation is now a lot safer. The transfer stages, from the melt unit to the ladle and from the ladle to the holding furnace, have been eliminated and the dangers (and costs) from molten metal spillage have been reduced substantially.

We believe that these benefits offer us a better working environment for our employees as well as providing us with substantial and sustainable cost savings.

Ian Maycock, General Manager, Quinton Hazell Automotive Ltd

The 'in-house' foundry at Brook Hansen is proud of the achievements it has attained in the development of metal melting facilities at its Huddersfield factory.

Faced as all businesses are with rising costs and in particular the rise in energy costs, the Company joined forces with British Gas to pursue the requirements needed to reduce overall running costs and increase efficiency throughout its foundry operation.

Following the successful introduction of a bulk melting facility supplied by Striko UK Ltd to the Huddersfield site, British Gas and Brook Hansen drew up a list of criteria which were considered to be of critical importance when operating a melting/holding facility in an aluminium foundry.

In the detailed specification was the need to reduce energy costs, and to have responsive and accurate temperature control, thereby extending crucible life and keeping metal loss to a minimum.

Brook Hansen in co-operation with British Gas and Striko embarked upon designing and building a prototype furnace with high efficiency insulation to reduce heat losses and maintain a cool outside temperature.

The savings proved to be substantial with the result that Brook Hansen has, to date, installed 13 furnaces with capacities ranging from 250 - 500 kg.

David Bolger, Site Services Executive, Brook Hansen Huddersfield

QUINTON HAZELL AUTOMOTIVE LTD

Quinton Hazell Automotive Ltd is a member of the UK based Echlin Group and a major supplier of water pumps, steering and suspension parts to the automotive industry. The company employs about 400 people at its Colwyn Bay site with approximately 30 in the foundry.

BROOK HANSEN, HUDDERSFIELD

Brook Hansen, part of BTR plc's Power Drives Group, is a leading manufacturer of electric motors. The company employs approximately 730 people at its Huddersfield site.

RESULTS AND CONCLUSIONS

Table 1 Average running costs (wet feed)

Description	Gas-fired CMHG	Gas-fired conversion from oil-fired furnace	Gas-fired furnace	Electric resistance furnace
Energy cost per casting	0.30p	1.24p	2.0p	4.6p (2.1p)
Energy cost per tonne	£3.86	£13.65	£23.68	£22.06 (£10.30)
NB Figures in brackets denote night rate				

QUINTON HAZELL LTD

The Striko MB furnaces at Quinton Hazell have resulted in a number of benefits including:

- reduced energy costs of £21,510/year;
- decreased manning levels worth £19,080/year;
- metal losses reduced from 3% to less than 1%, saving £17,500/year;
- reduced consumable costs worth £ 8,900/year;
- lower maintenance costs worth £ 2,700/year.

Total annual savings of £69,690 were achieved, and the following additional benefits, were noted but not quantified:

- a refractory life of between five to ten years compared with a crucible change of every four months with the original design;
- scrap levels reduced from 12% to 4% (estimated) through improved metal quality, resulting in faster throughput and improving customer relations.

Clearly these additional benefits increase the value of the savings, further reducing the payback period on the investment.

BROOK HANSEN, HUDDERSFIELD

Table 1 gives details of running costs for wet feed on various furnaces at Brook Hansen. The results show that the CMHG model has significant cost benefits over other furnace types. In addition, crucible life has been extended, equivalent to at least one less change per year, with associated savings in down time. Each crucible costs approximately £350.

Based upon the results of comprehensive testing carried out by British Gas, Brook Hansen expects to achieve annual savings of £58,000, offering a payback on investment of two years. The bulk of these savings were energy, with additional cost savings coming from reduced maintenance costs, consumables and metal losses. As a measure of its confidence, the company has recently purchased and installed its fourteenth CMHG furnace.

ECONOMICS

Quinton Hazell and Brook Hansen achieved payback periods of 1.6 years and two years respectively.

These payback calculations are for replacing existing operating units. However, for a foundry which needs to replace its melting and holding equipment, payback should be calculated on the marginal capital costs rather than the total outlay. For example, the CMHG melt/hold unit costs approximately £10,000, while rebuilding a non-energy efficient unit would cost approximately £4,000. The marginal additional cost of the energy efficient unit would therefore be £6,000. As each unit saves, on average, £4,800/year, the payback period on the marginal extra investment is only 15 months, rather than two years.

The Department of the Environment's Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. The information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Further information

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Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R & D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating, lighting etc.